Numerical Ocean Models

- 1-2 km resolution models in Monterey Bay and Southern CA Bight
- 3 km resolution model covering ocean off all of California
- Drop-a-drifter and other trajectory tools
- Cross-sections
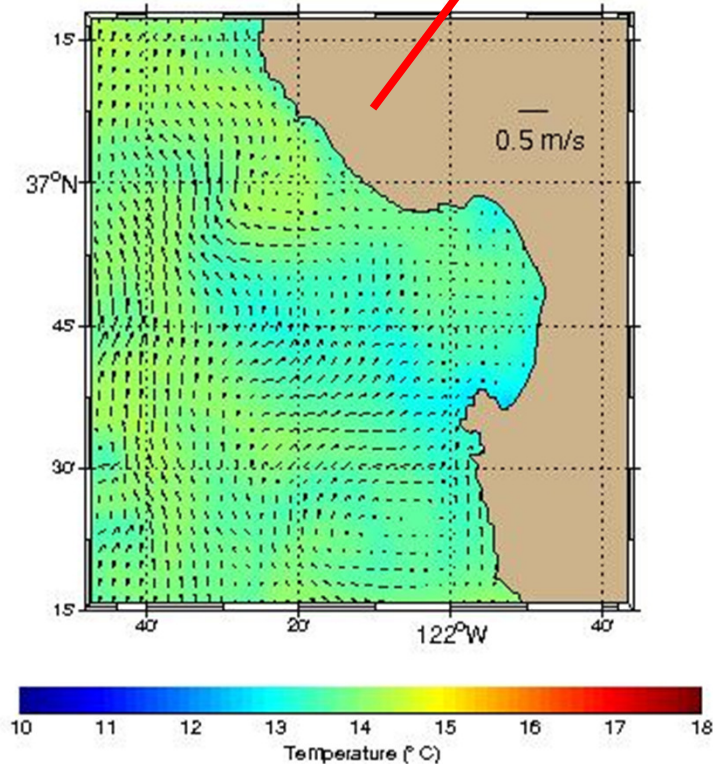- 12 km resolution model running for area off whole West Coast

Jan. 8, 2013

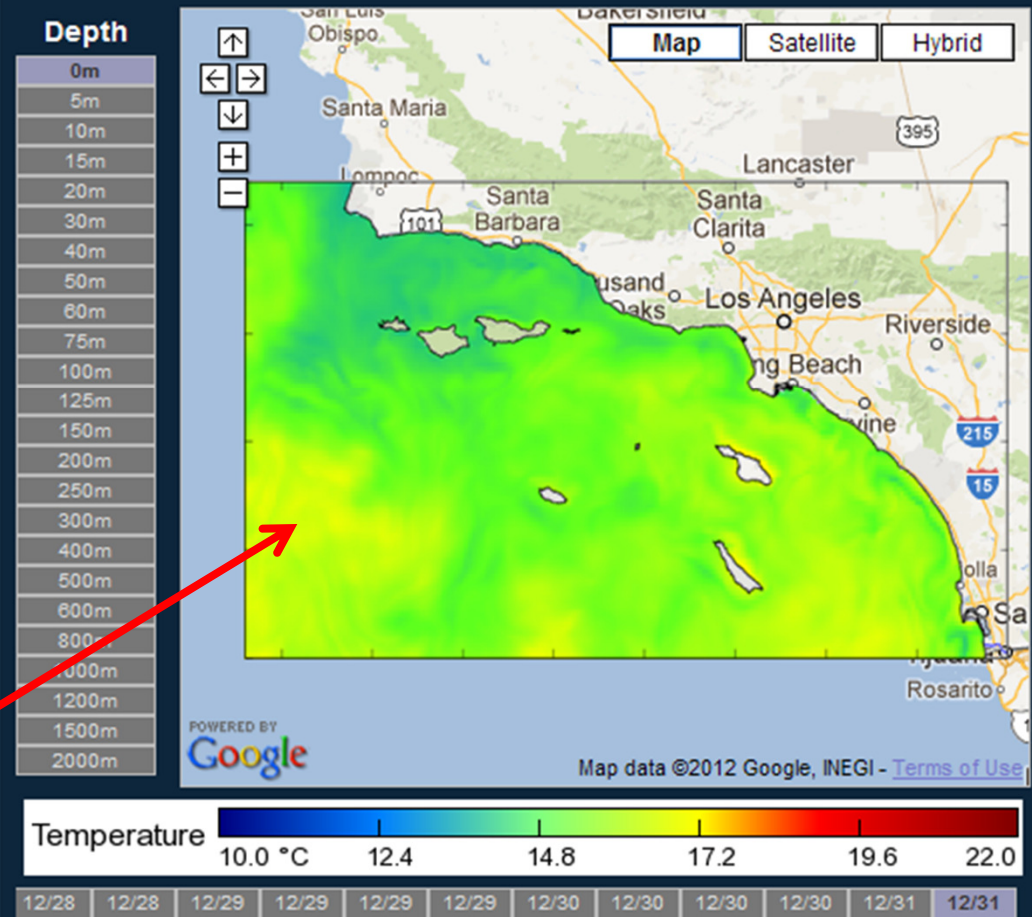# 1-2 km resolution models in Monterey Bay and Southern CA Bight

http://www.cencoos.org/sections/models/ROMS.shtml

Temp (°C, color), Current (m/s, arrows) at 0m for 12/17/2012 at 3GMT

0.5 m/s

Regional Ocean Model System (ROMS) Model Output

The ROMS model is produced and distributed by NASA JPL and is available from http://ourocean.jpl.nasa.gov/SCB/.
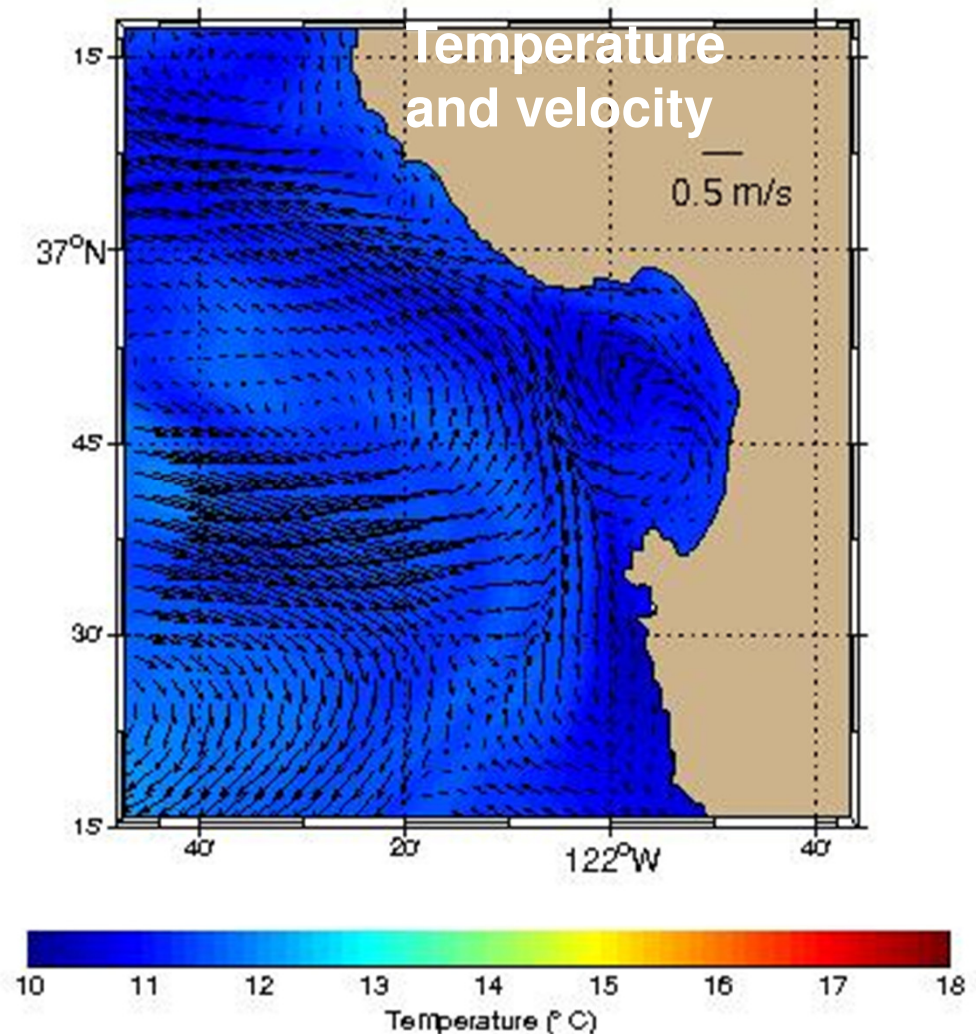
http://www.sccoos.org/data/roms/

UCLA/JPL ROMS
Monterey Bay

- 1.5 km resolution
- T, S, velocity, SSH
- Nowcast every 6 hr
- 48 hr forecast
- NetCDF data files available

Temp (°C, color), Current (m/s, arrows) at 0m for 04/14/2012 at 3GM

Temperature and velocity

0.5 m/s

Temperature (°C)

"Drop-a-Drifter" tool
http://ourocean.jpl.nasa.gov/MB/mbmangen.jsp

"Drop-a-Drifter" Surface Water Trajectories in Central California

Click the image below to view this Google Map based tool at the website for NASA's Jet Propulsion Lab (JPL) where the product was created. The movement of a particle of surface water (the trajectory) can be computed during the past (since Oct. 4th, 2010), present and future (48-hrs ahead). This can be used to indicate where any floating substance (oil etc.) or object (buoy etc.) came from or will go. Choose a starting point for a trajectory by "dropping" a virtual drifter marker on the map. The drifter path will be indicated by a colored line based on the dates selected. If you wish to determine the origin of something found floating or on the beach, please use the multiple drop mode and: select an end time of whenever it was found and a start time previous to the end time, then drop multiple drifters over a large area to see the most likely origin. Trajectories are determined using the Regional Ocean Modeling System (ROMS). Note: although several data sources are incorporated in ROMS, the drifter tool has not yet been validated with actual data.

Drop-a-Drifter Surface Water Trajectories Product

Get to this under Data Products menu

For multiple drifters,

Click to see push pin;

Drag mouse to get box

Click again

Choose compute & plot

"Drop-a-Drifter" Surface Water Trajectories

http://www.cencoos.org/sections/products/drop_a_drifter.shtml

http://ourocean.jpl.nasa.gov/SCB/scbmangen.jsp

○ Single Drop Mode   ● Mutiple Drop Mode
(Click & then move the mouse to draw a region for drifters)

Number Of Drifters:

X dimension: 3   Y dimension: 3

Location

Lon: [   ]   Lat: [   ]   [Add Drifter]

If you wish to determine the origin of something found floating or on the beach, please use the multiple drop mode and: select an end time of whenever it was found and a start time previous to the end time, then drop multiple drifters over a large area to see the most likely origin.

Data Source
ROMS 72hr Forecast ▾
Start Time (GMT)
2012-09-06 ▾   03:00:00 ▾   Parameters
End Time (GMT)
2012-09-09 ▾   03:00:00 ▾

[Compute & Plot]   [Clear]   [Download Trajectory File]
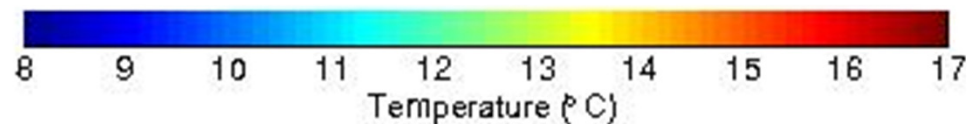
CeNCOOS 3 day est. Trajectory

SCCOOS 3 day est. Trajectory

3 km resolution model covering ocean off all of CA

http://ourocean.jpl.nasa.gov/CA/
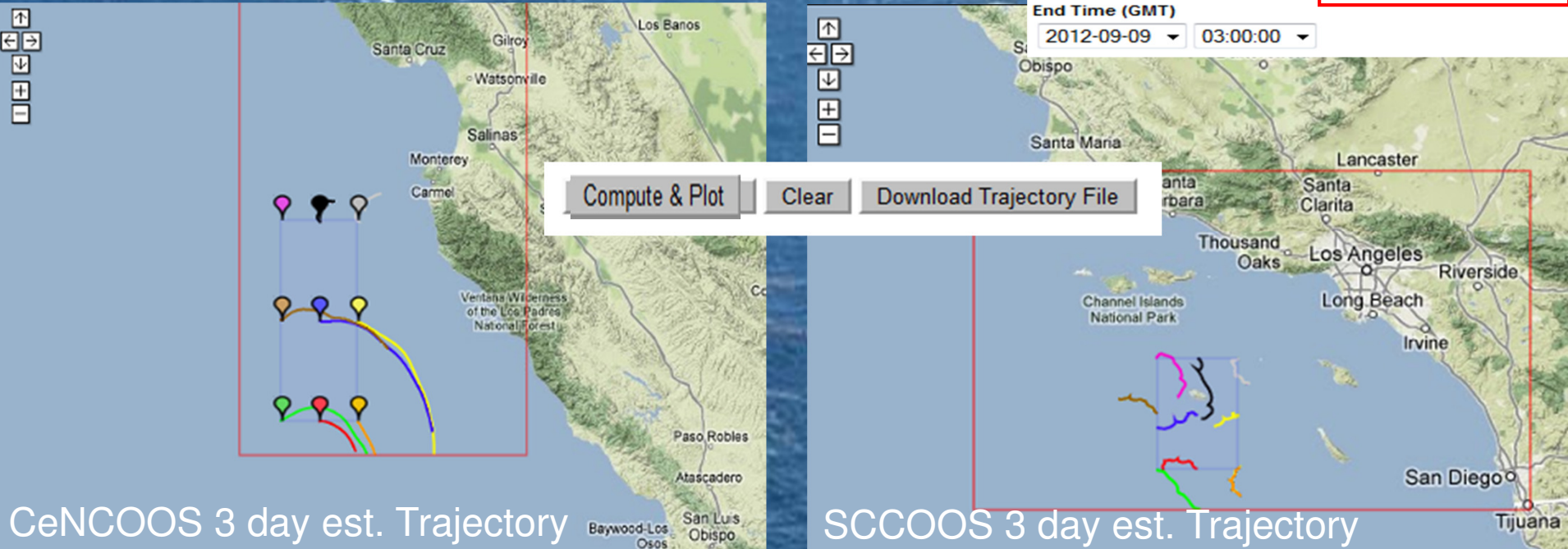
Temp (°C, color), Current (m/s, arrows) at 0m for 01/01/2013

Temperature and velocity
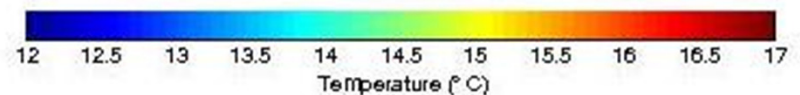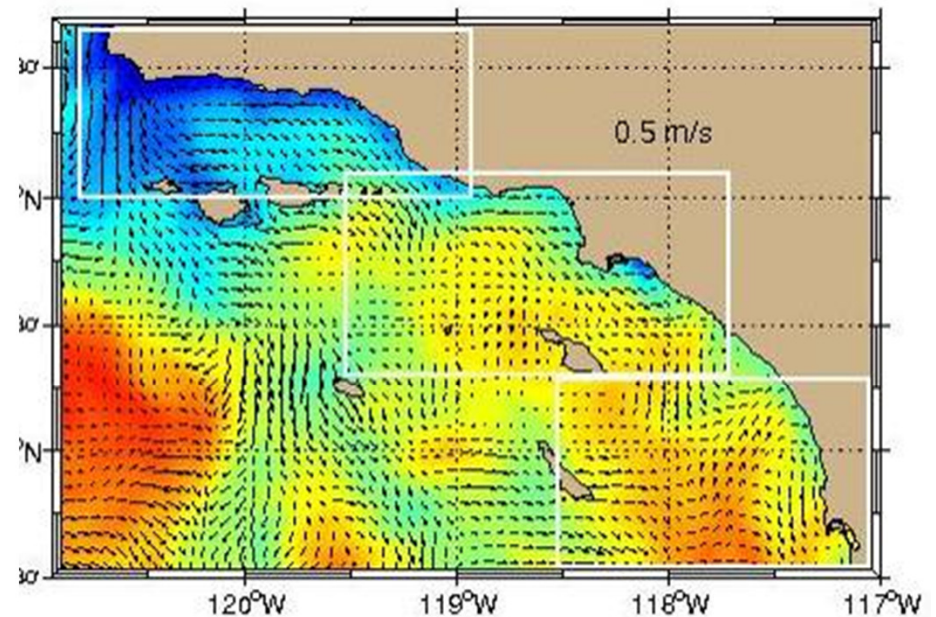
UCLA/JPL ROMS - California

- 3 km resolution
- T, S, velocity, SSH
- Nowcast every 6 hr
- 72 hr forecast
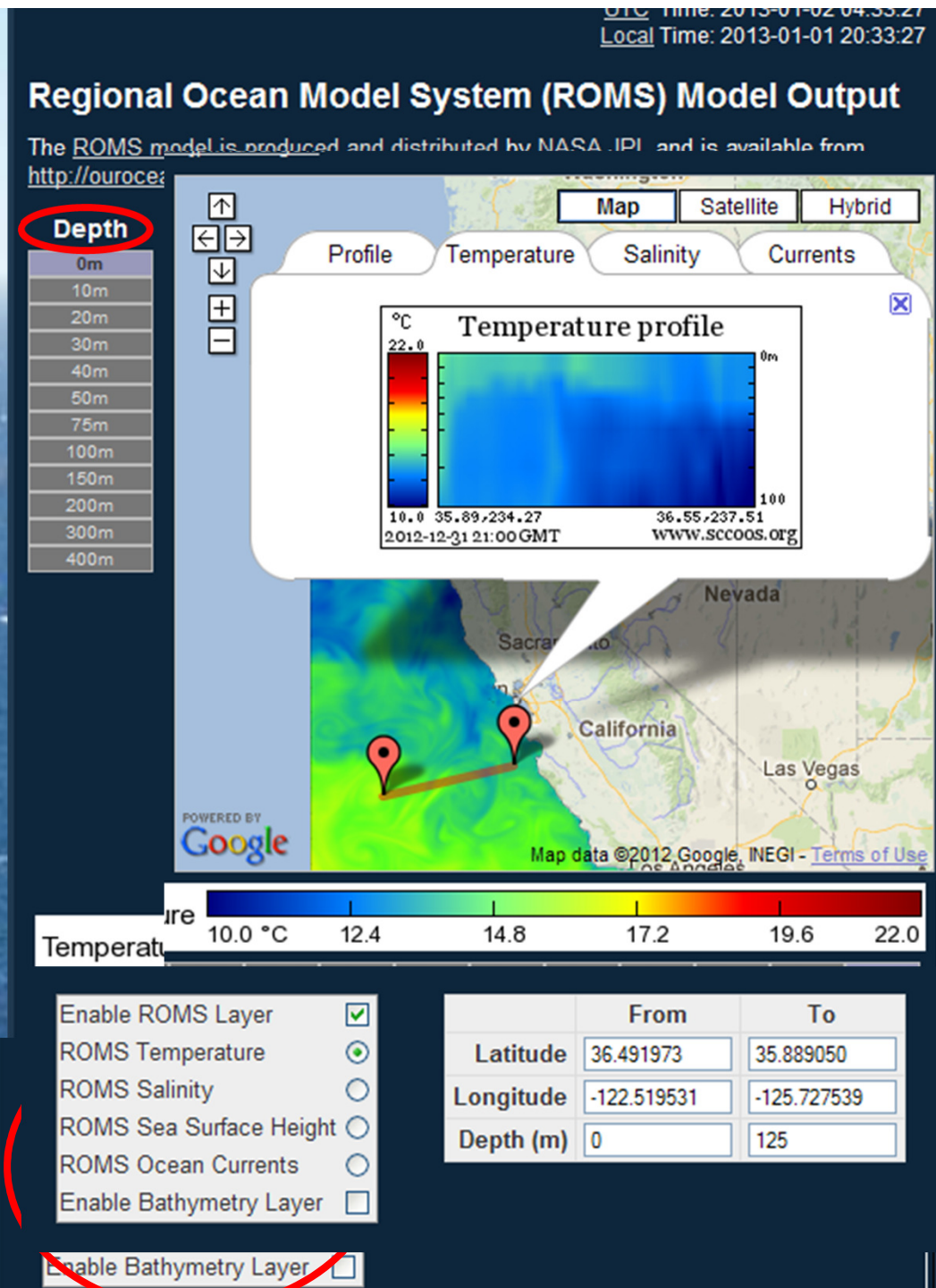- Data files available via THREDDS
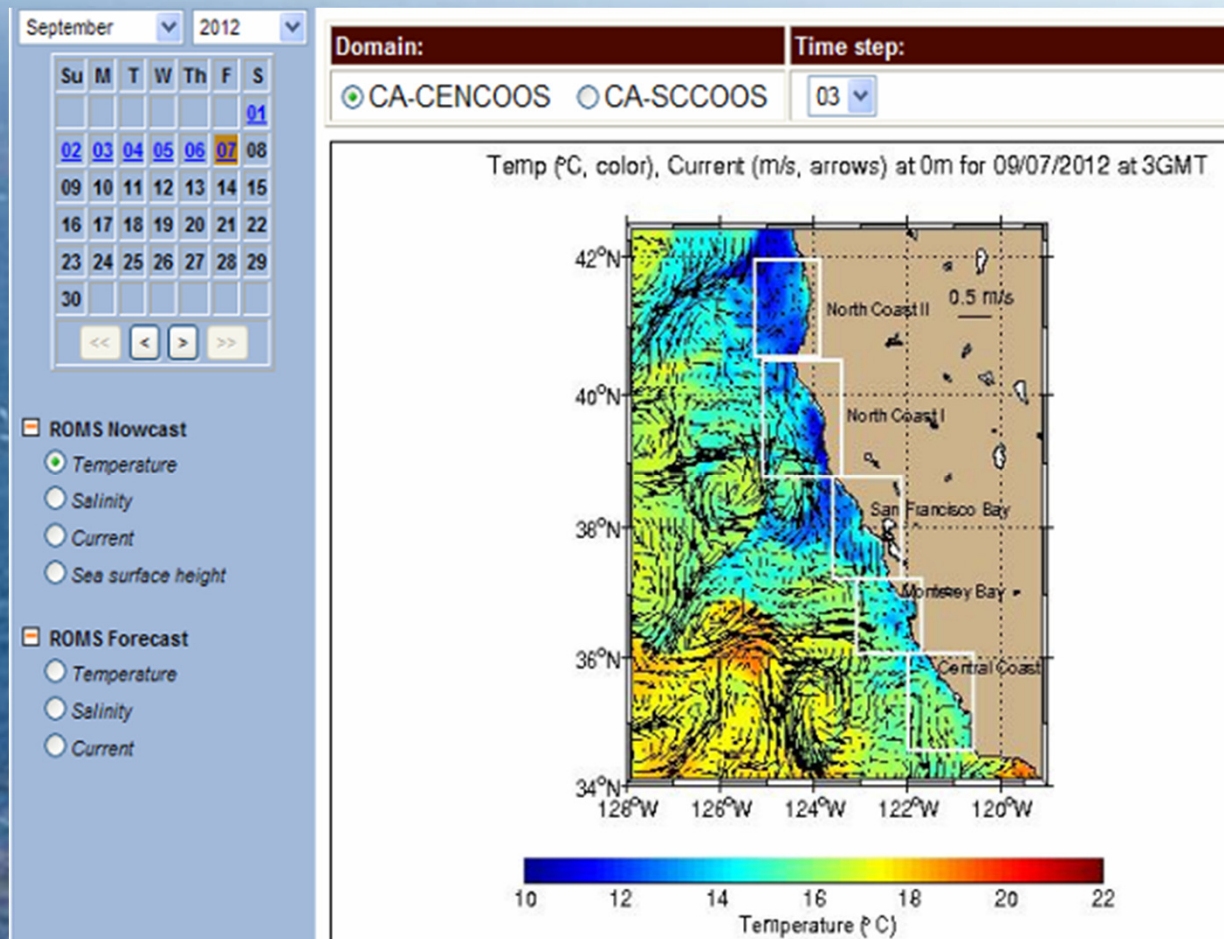
# Through the SCCOOS interface to the CA ROMS

www.sccoos.org/data/roms-3km

- Different depths, times, and variables, can be chosen for display

- Vertical profiles at a point may plotted

- Cross-sections of different variables may be plotted

Note: does not work with Internet Explorer

CeNCOOS product under development

- Based on CA ROMS 72-hr current forecasts
- "Drifters" start at every 10th model grid point
- ½ hr time steps are used for the advection; black "tail" is 12 time steps (6 hrs) long
- Gray tail extends back to the starting location.
- Temperature field is updated every hour
- Temperature contours are every degree from 6 to 20 °C

Particle Trajectories From JPL ROMS run
Currents at 18–Dec–2012 00:00 GMT
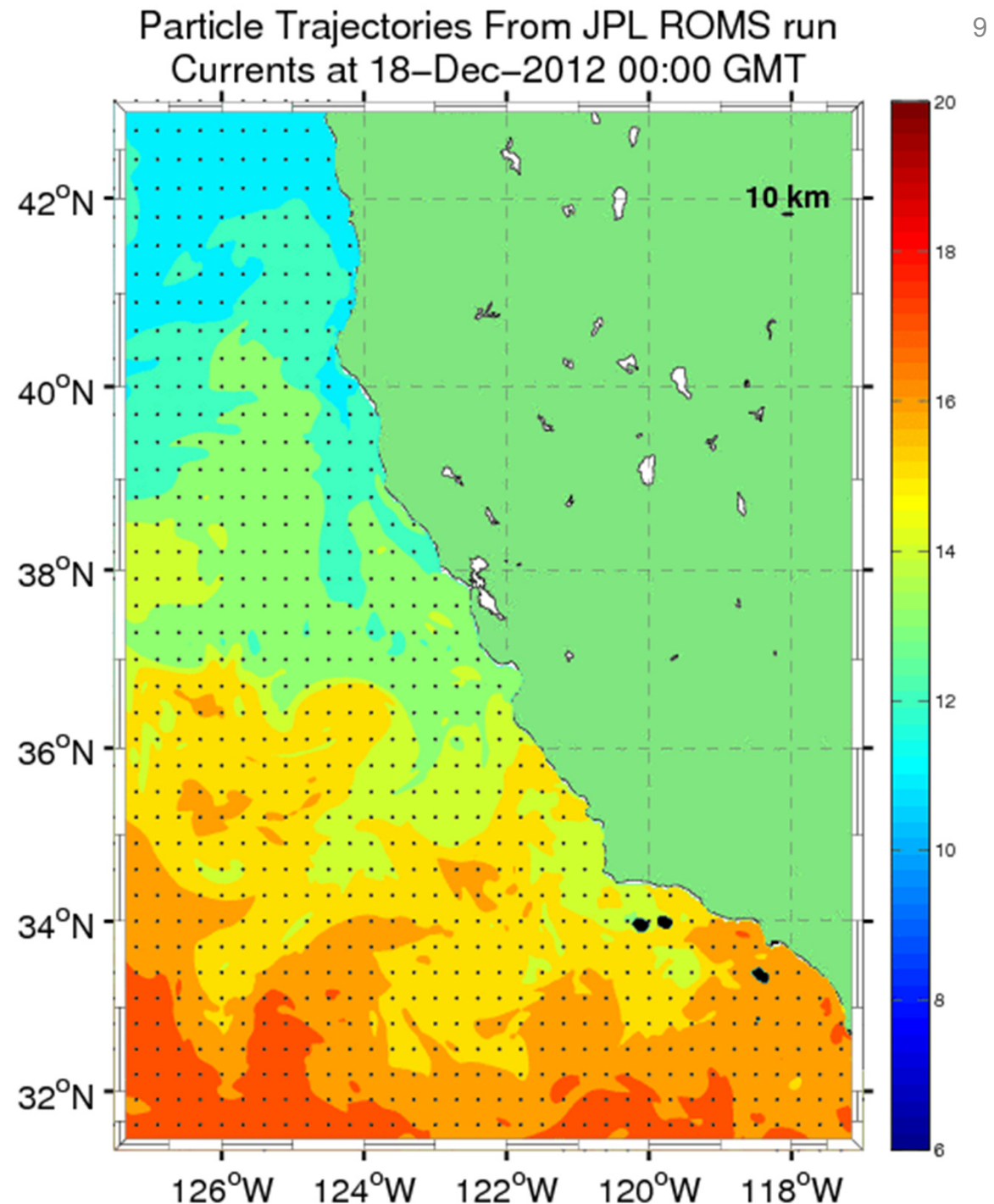
12 km resolution model for whole West Coast
http://www.cencoos.org/sections/models/UCSC_ROMS.shtml

- 4D VAR
- 1/10 deg resolution
- T, S, velocity, SSH
- Figures updated daily
- Hindcast and nowcast
- NetCDF data files available
- Developed and run by UCSC

Nonlinear Model Output
Salinity and Horizontal Velocity 13-Apr-2012 00:00:00 - Depth 2 m
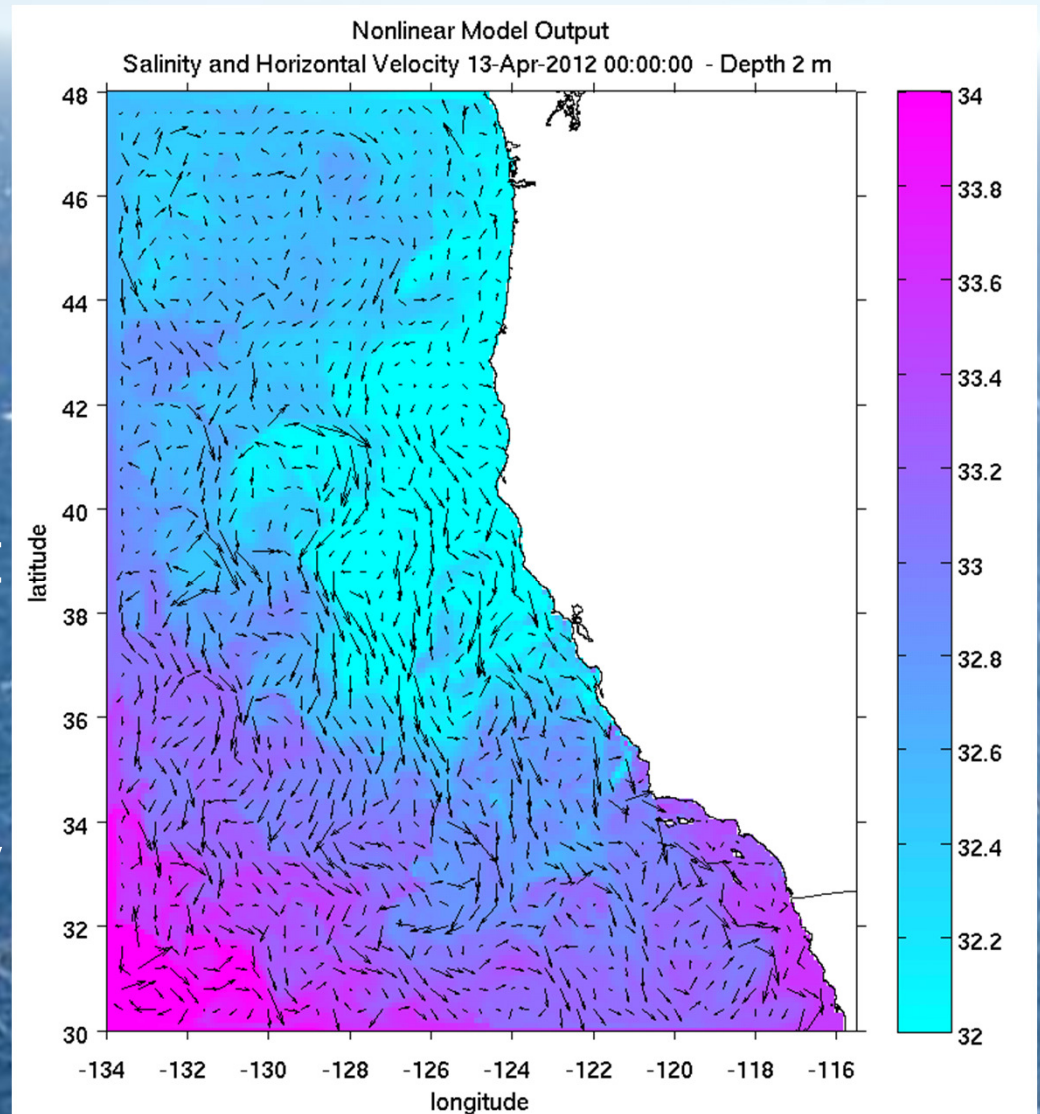
Biological and geochemical forecast models under development or consideration

- Statistical models relating ocean conditions to HABs

- Linked hydrologic, ocean, atmosphere models to forecast salmon populations

- Coupled physical/NPZD (nitrogen, phytoplankton, zooplankton, detritus) models for ecosystem forecasts

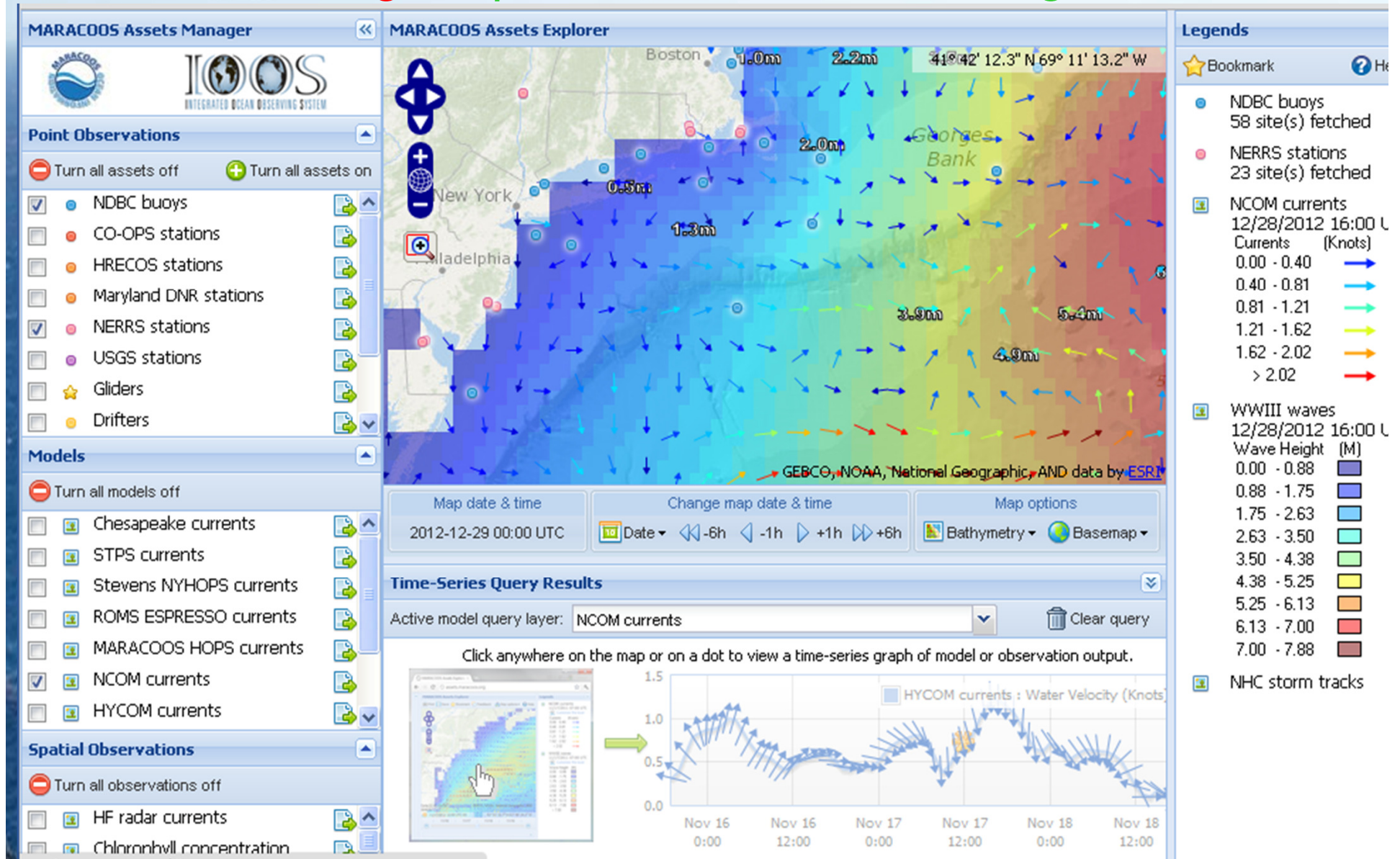- Geochemical modeling to identify natural and outfall-based sources of nutrients

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Geoportal viewer integrating multiple asset types
e.g. http://assets.maracoos.org

Case Study 1: Oil Spills

- ## Cosco Busan hit Oakland Bay Bridge Nov. 7, 2007
    - 2004-present Establishment of California HF Radar array
    - 2005 IOOS office supports CORDC to develop HFR national network distribution
    - 2006 SafeSeas06 was the first collaborative effort between OOS and NOAA OR&R netCDF format standardized,
    - 2007 *CoscoBusan* incident used HFR in spill predictions, development of GIS format
    - 2008 HF Radar integration into both Office of Spill Prevention and Response (OSPR) and Office of Response and Restoration for GNOME forecasting model and used in National Preparedness for Emergency Response Planning (NPREP)

- ## Deepwater Horizon well blowout Apr. 20, 2010
    - April 20, 2010 No Gulf of Mexico HF Radar systems online
    - April 24, 2010 University of Southern Florida Systems online in national network
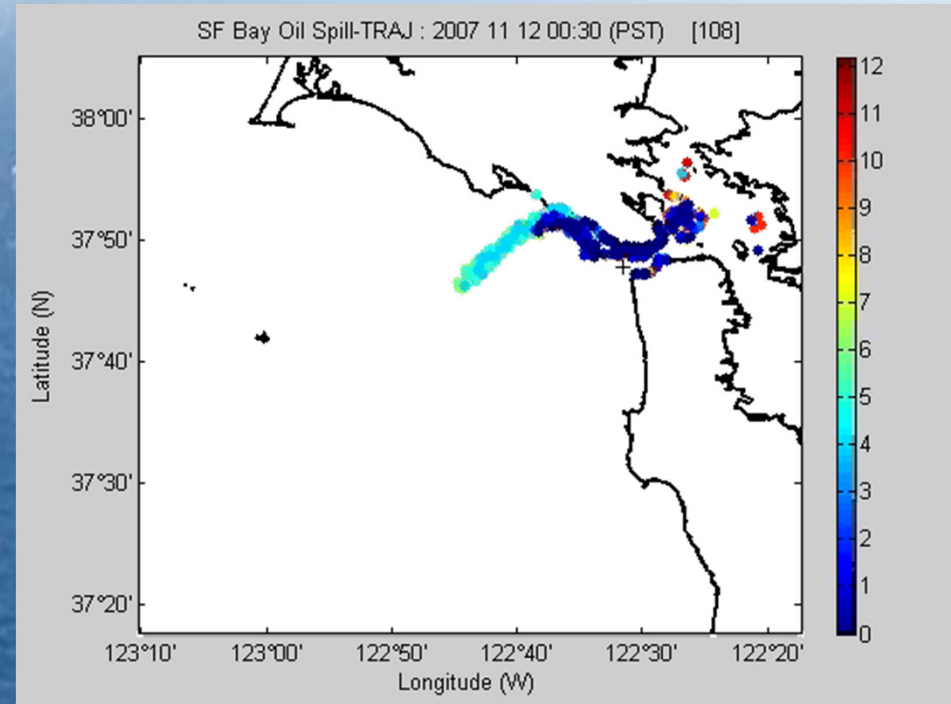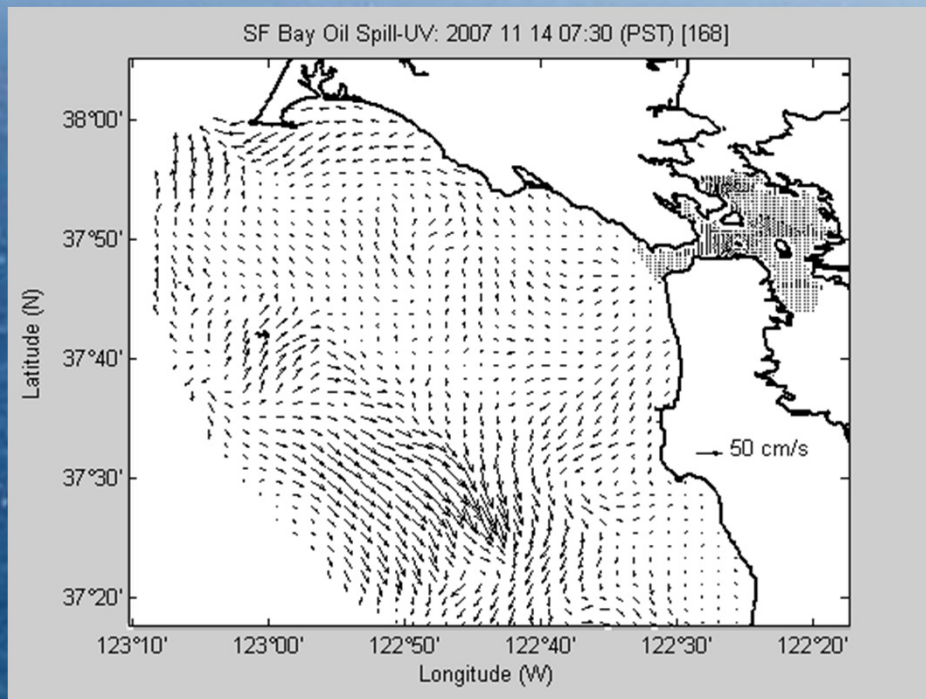   - May 01, 2010 University of Southern Mississippi systems online in national network

**Jan. 8, 2013**

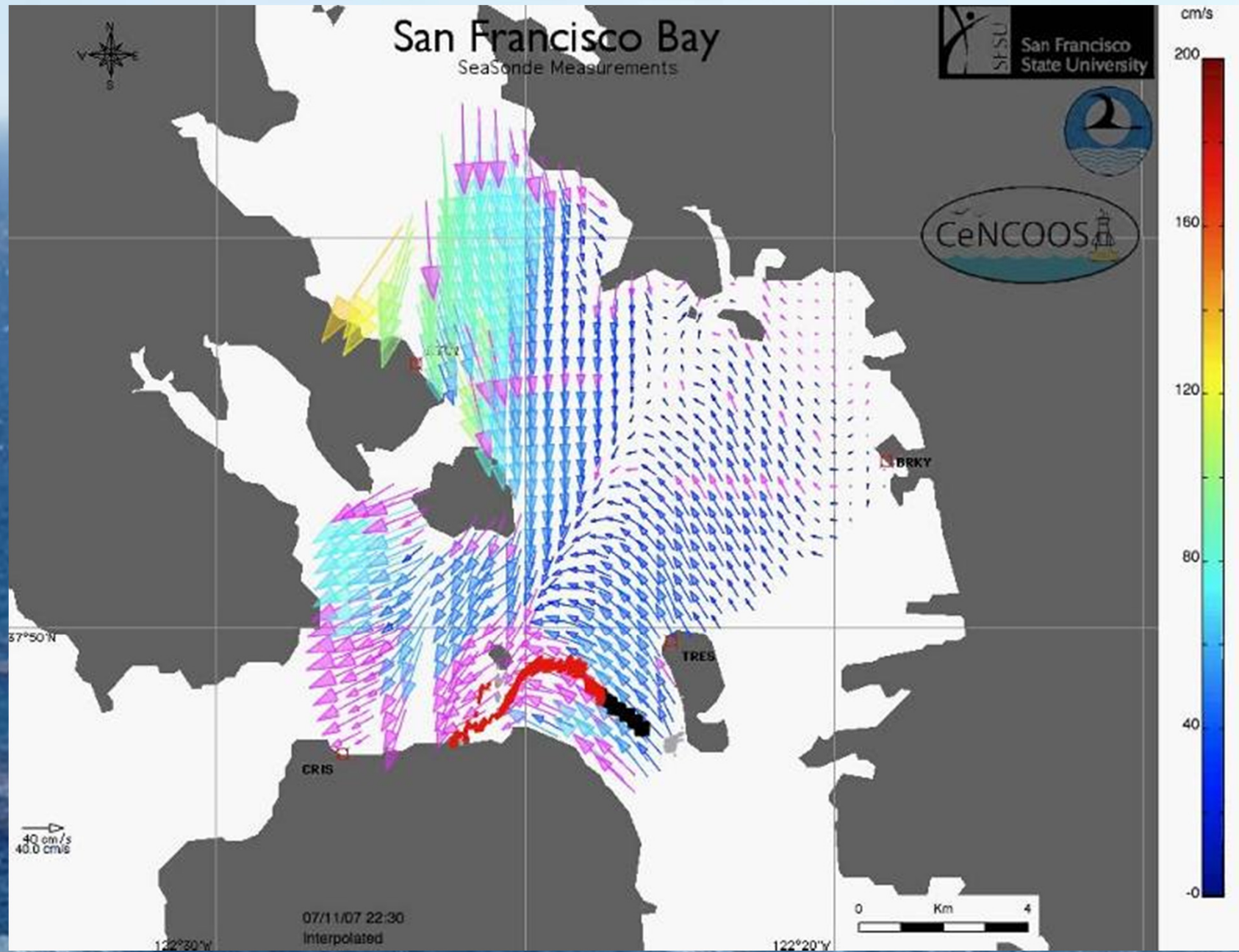# Cosco Busan, San Francisco Bay
Gap filled data, Trajectories

Oil spilled or flowing into offshore waters is within an environment where HF radar observations can be uniquely helpful in tracking and predicting movements

CeNCOOS and Cosco Busan Spill
http://www.cencoos.org/sections/news/SF_oil_spill_2007.shtml

http://norcalcurrents.org/COCMP/oil_spill.html
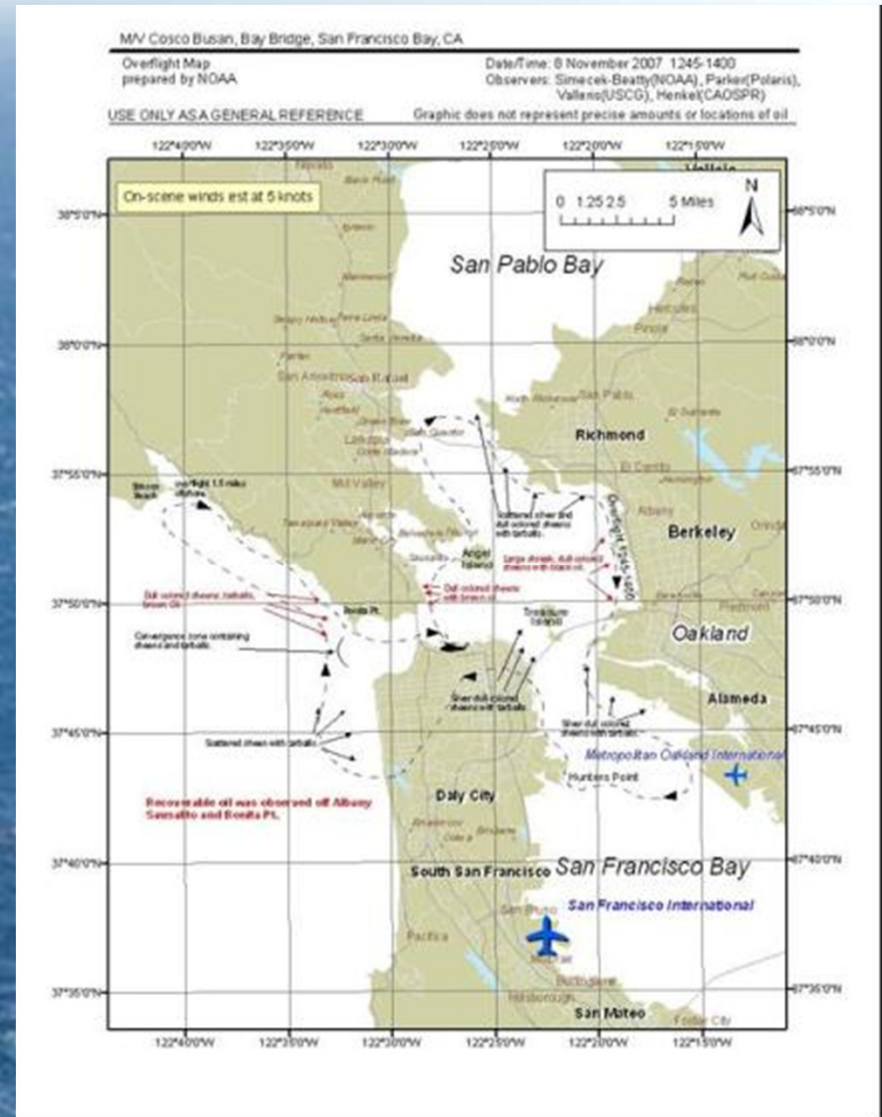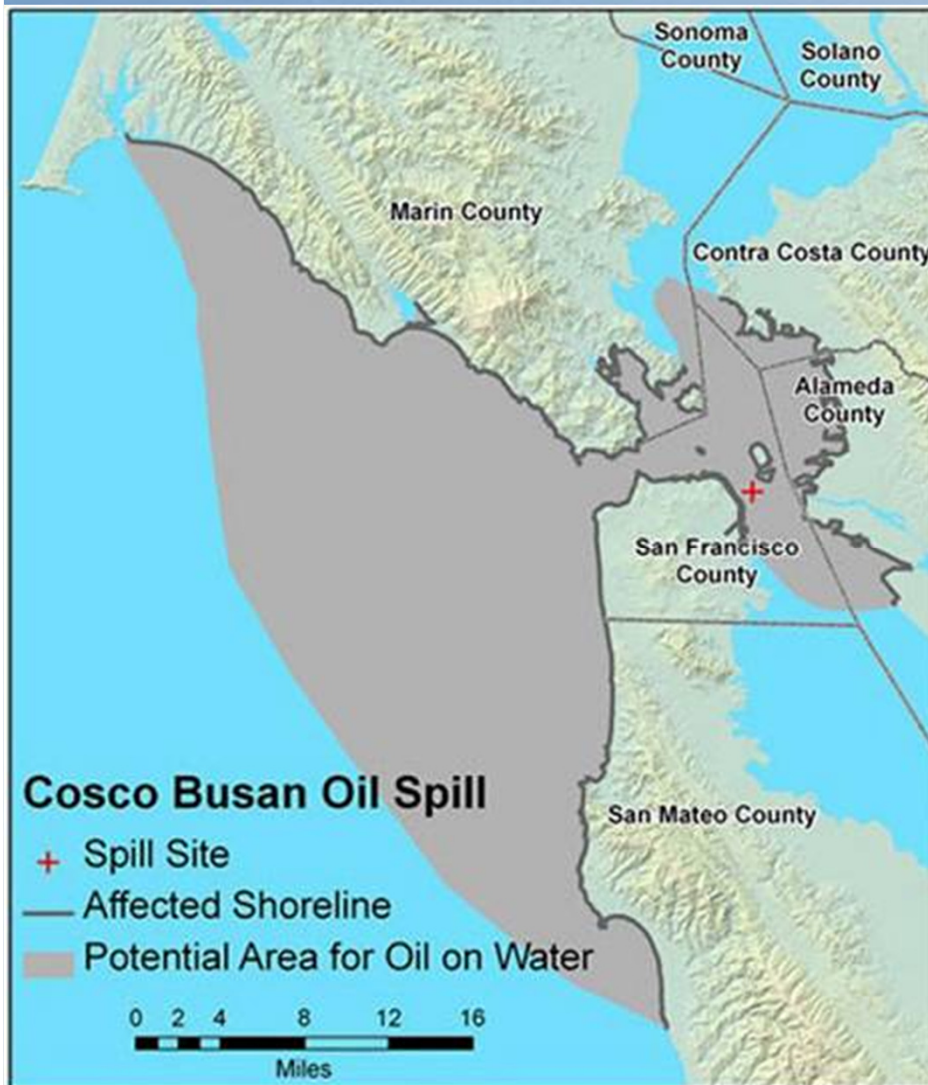
Predicted Drifter Tracks for 10 November 2007 GMT

Based on Predicted Surface Currents

- Predicted Drifter Track
- Track Starting Point
- HF Radar Antenna Locations

Farallon Islands

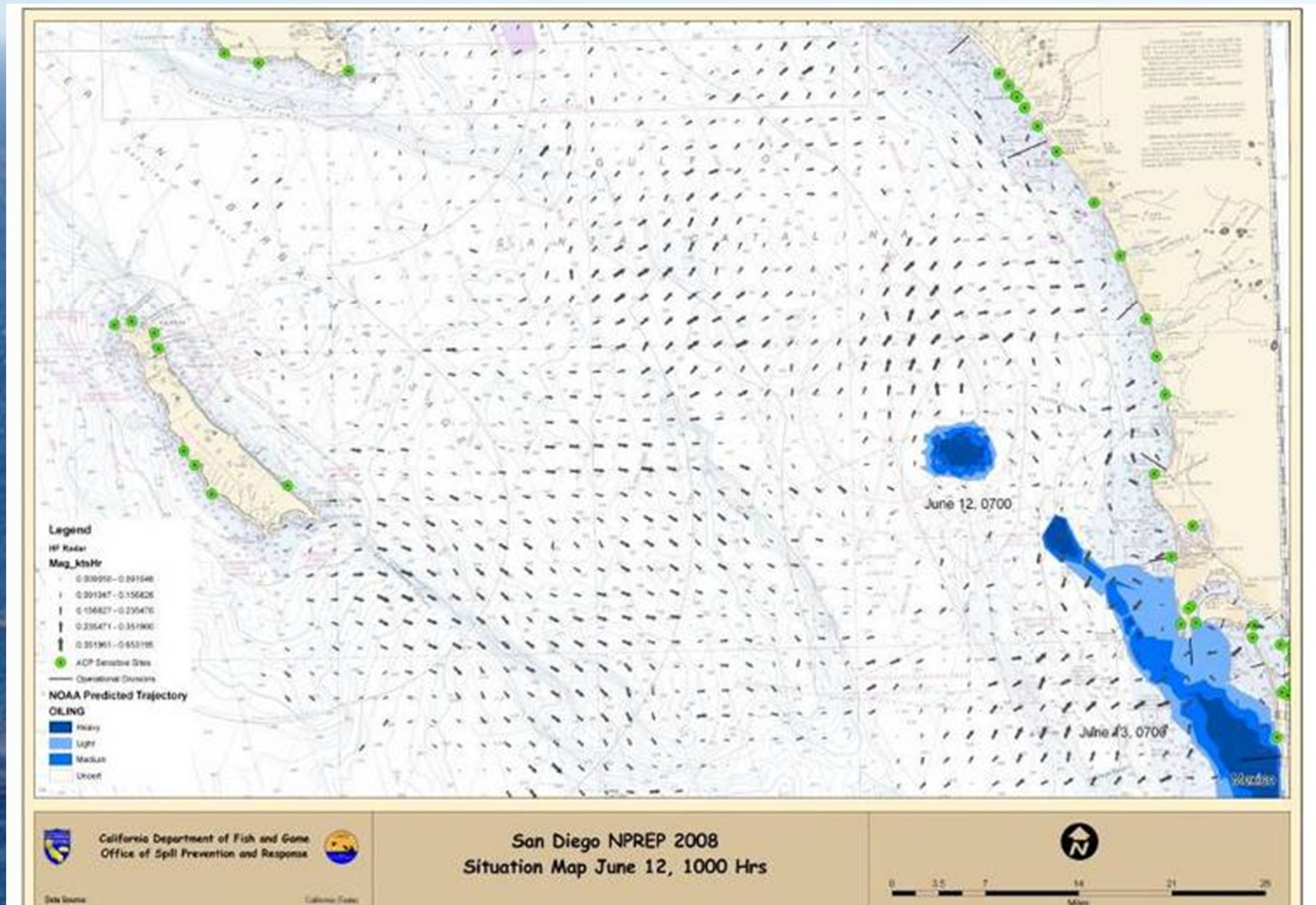San Francisco

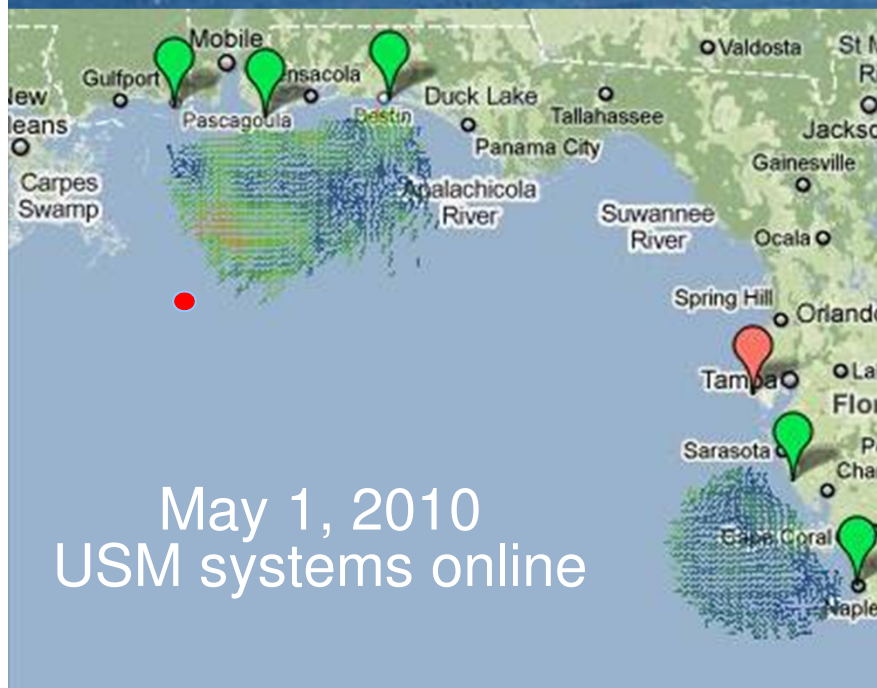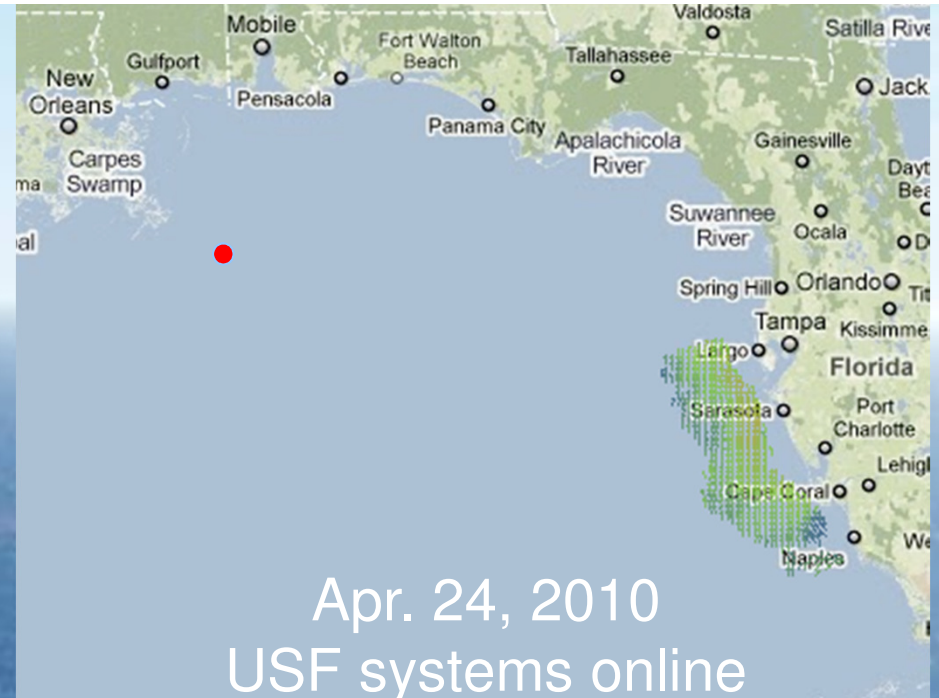**GIS format requested by OSPR**

Not Intended for Navigation

Working Draft
Do Not Circulate

Tim Reed, SIMoN/GFNMS, 10 Nov 2007

Data Courtesy of COCMP and CeNCOOS

Oil spill response: OSPR-generated response exercise map with integrated HFR surface current data (arrows show speed and direction)

Apr. 20, 2010
no systems operating

Apr. 24, 2010
USF systems online
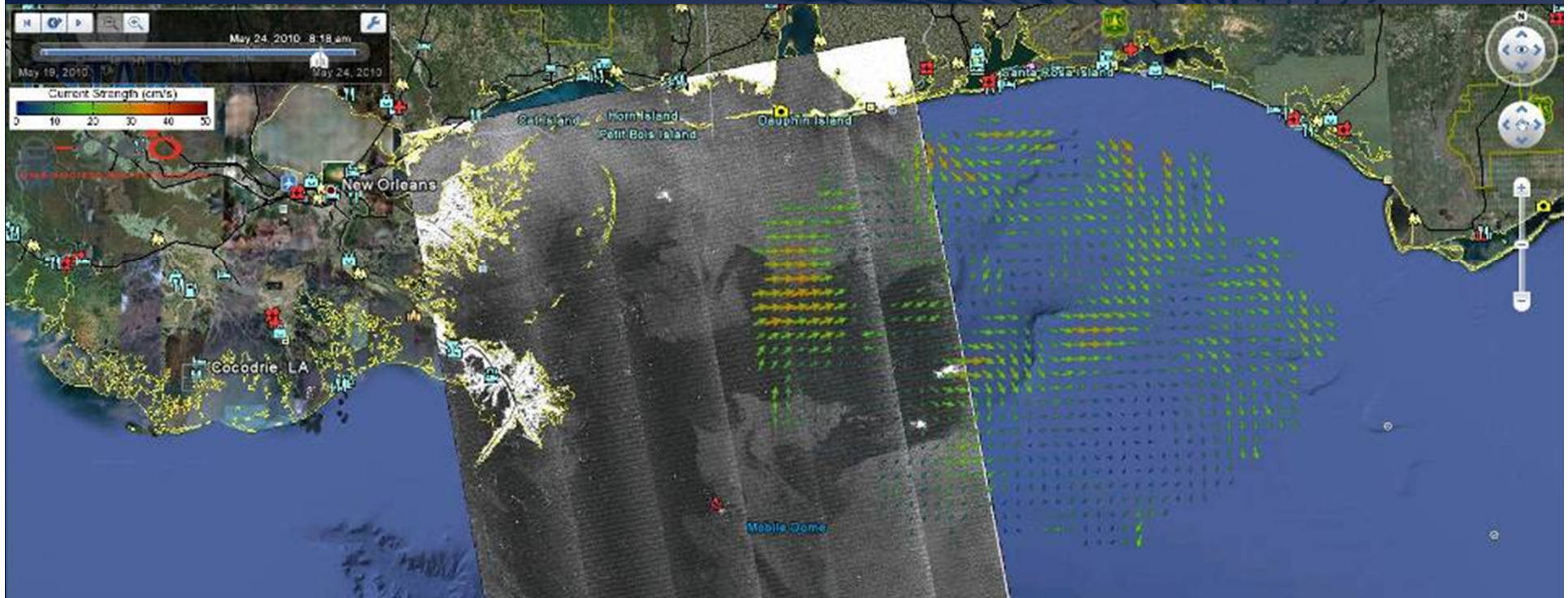
May 1, 2010
USM systems online

Improved network response and data integration between Cosco Busan and Deepwater Horizon

Mapping Surface Currents in Gulf of Mexico with HF Radar

Scripps Point of Contact: Eric Terrill (eterrill@ucsd.edu)
www.cordc.ucsd.edu/projects/mapping

Scripps HF Radar Activities in Gulf Of Mexico

- Developers of real-time data management and distribution system for national network (120+ radars). Leverages State of CA network.
- Processing of data for NOAA OR&R for official trajectories.
- Real-time Google products for data overlays.
- BP funded project to develop capability for HF radar on oil platforms

SAR imagery from CSTARS/UMIAMI. OI mapped HF Radar surface currents from CORDC/SIO. Radars operated by USM.
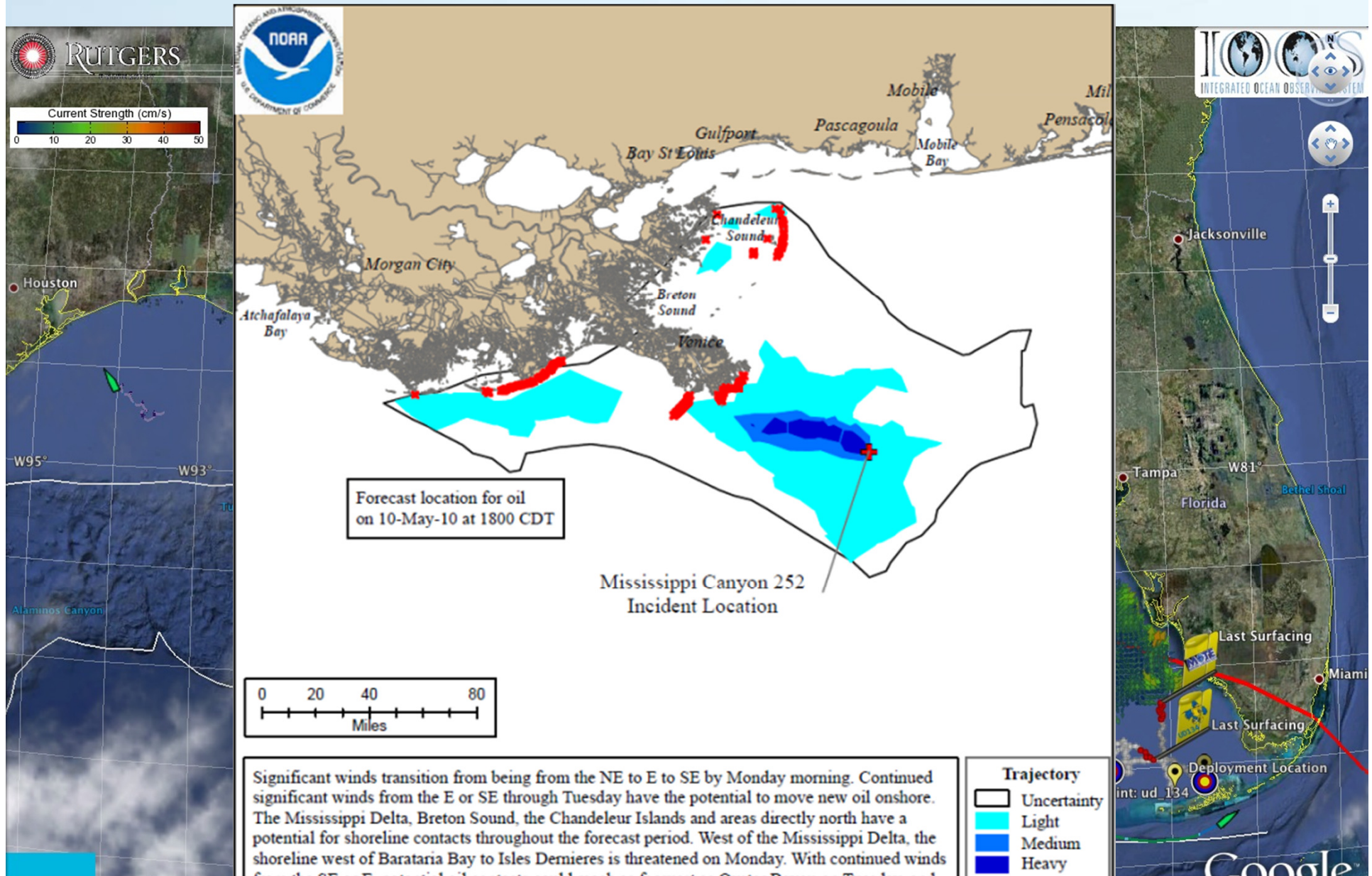
Integrated observations and model forecasts
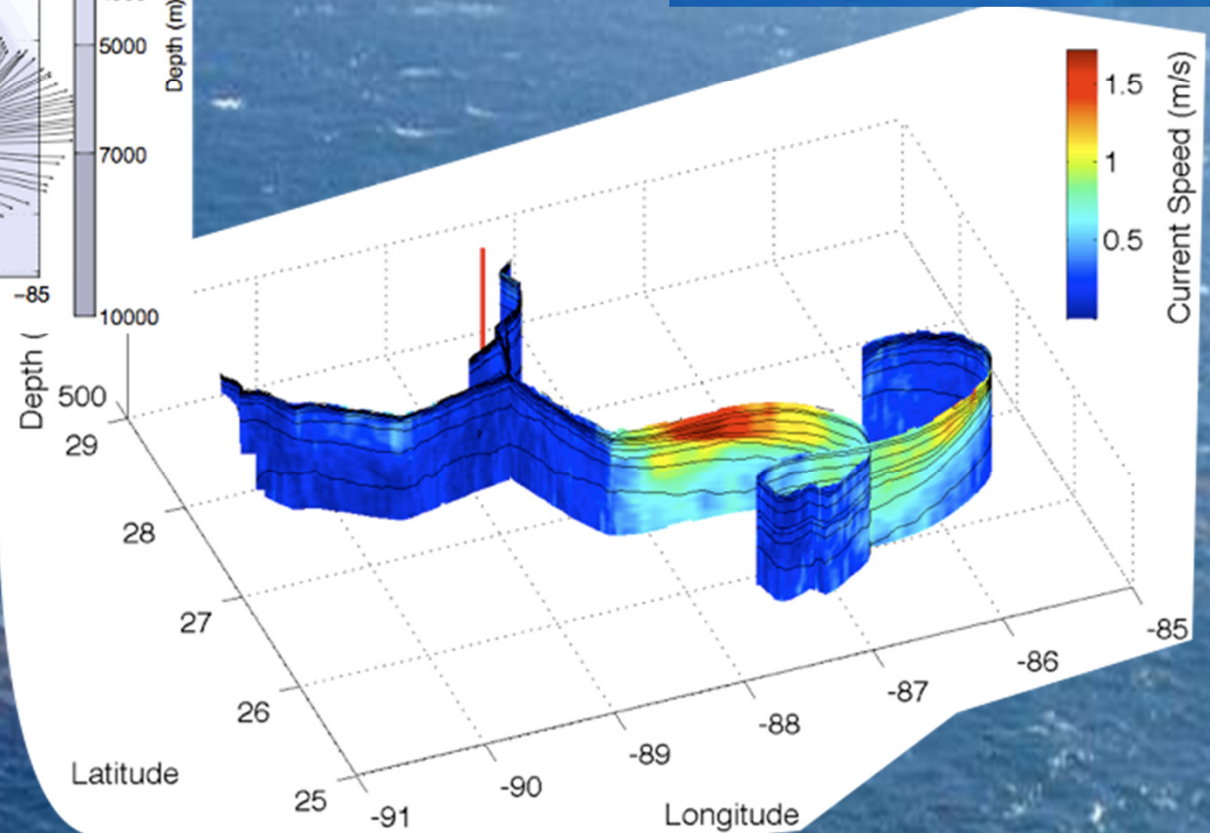## http://rucool.marine.rutgers.edu/deepwater

Subsurface Monitoring Using Autonomous Vehicles
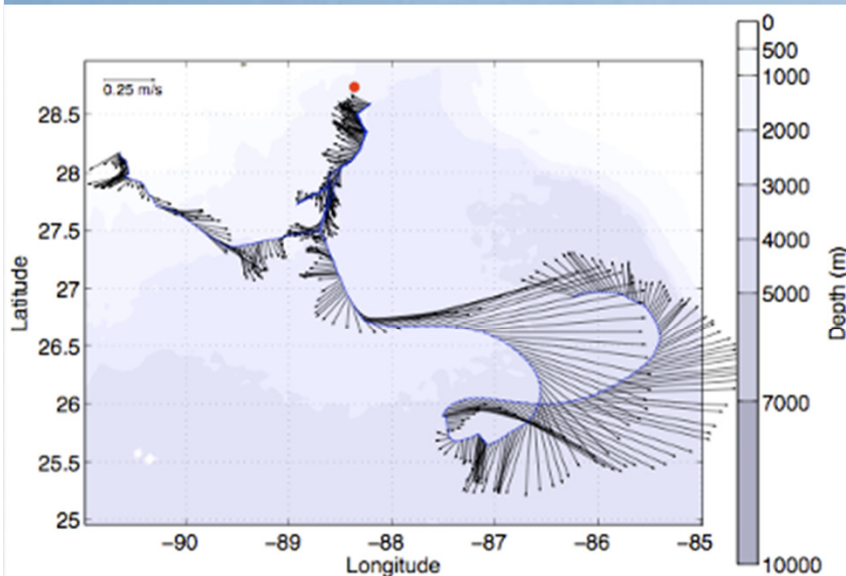
June 7 - July 26, 2010

Ocean Currents
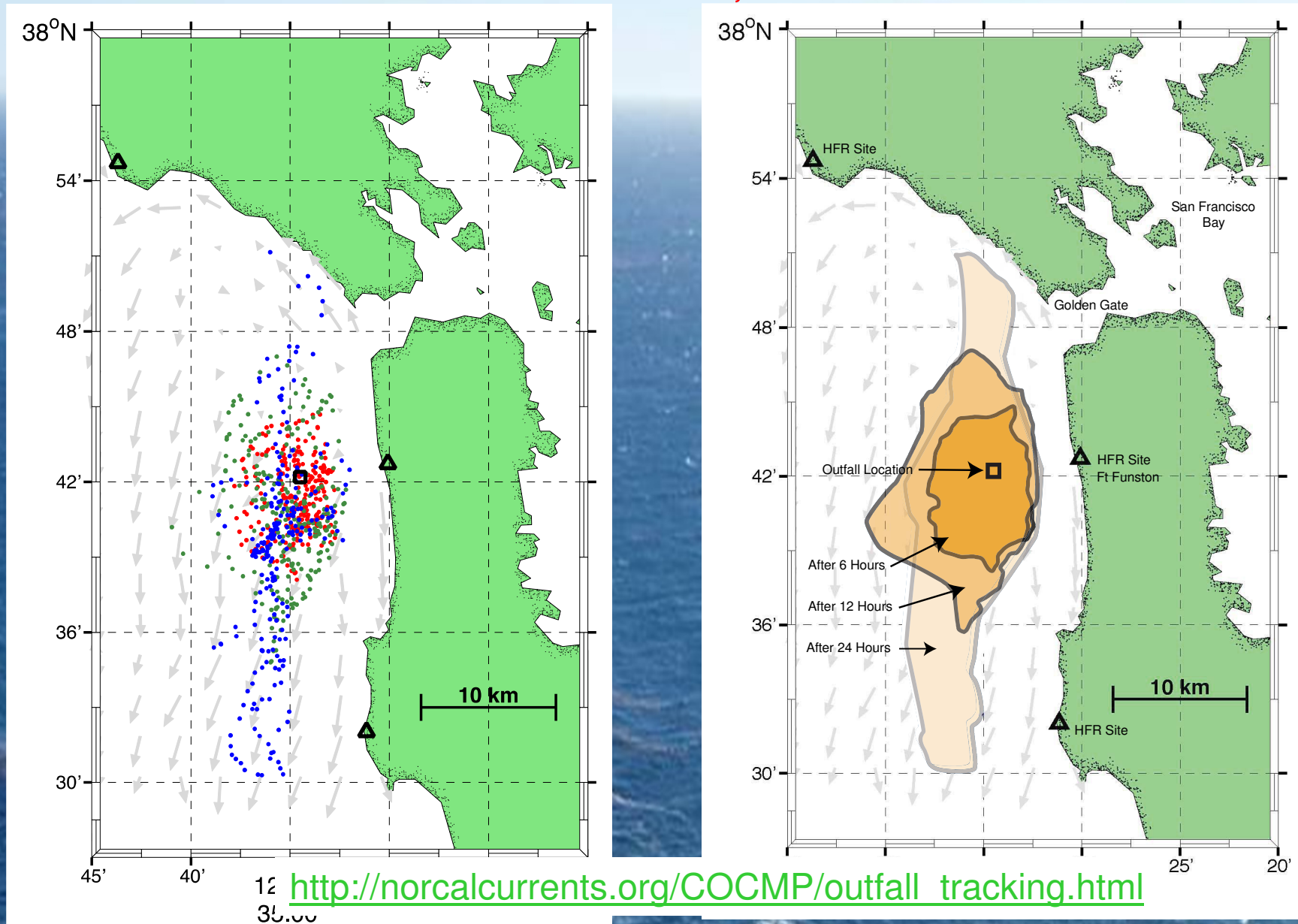
Case Study 2: Outfall and Coastal Plume Tracking

- SF Ocean Beach Outfall Accidental Release
- Orange County Sanitation District Outfall Diversion (September 2012)

Jan. 8, 2013

SF Sewage District Ocean Beach Outfall Discharge
October, 2007

http://norcalcurrents.org/COCMP/outfall_tracking.html

2012 Orange County Sanitation District (OCSD) Ocean Outfall Diversion

The Orange County Sanitation District (OCSD) discharges its treated effluent from a 120-inch ocean outfall that terminates in 200 feet of water, approximately 4.5 miles offshore Newport Beach and Huntington Beach.

On September 14, 2012 OCSD diverted the flow from the 120-inch outfall to the 78-inch outfall as part of a project to inspect, assess, and rehabilitate the Outfall Land Section and Ocean Outfall Booster Pump Station Piping.
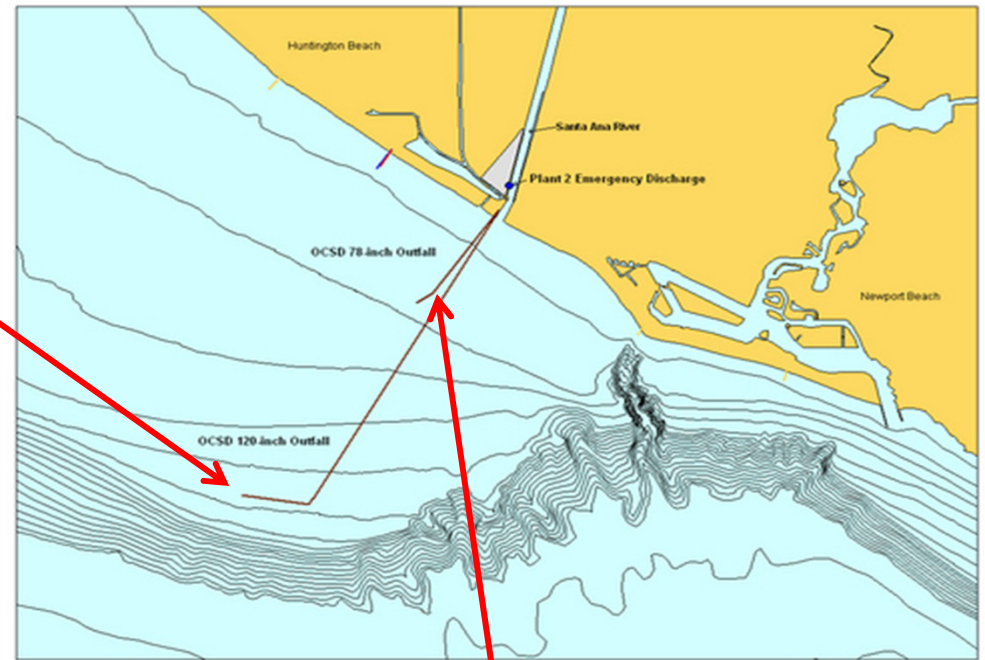
The District has a secondary, 78-inch outfall located in about 60 feet of water, 1 mile off the coast. Periodically, OCSD request special permits to divert effluent from the 120-inch pipe to the 78-inch pipe for emergency purposes and planned maintenance projects.
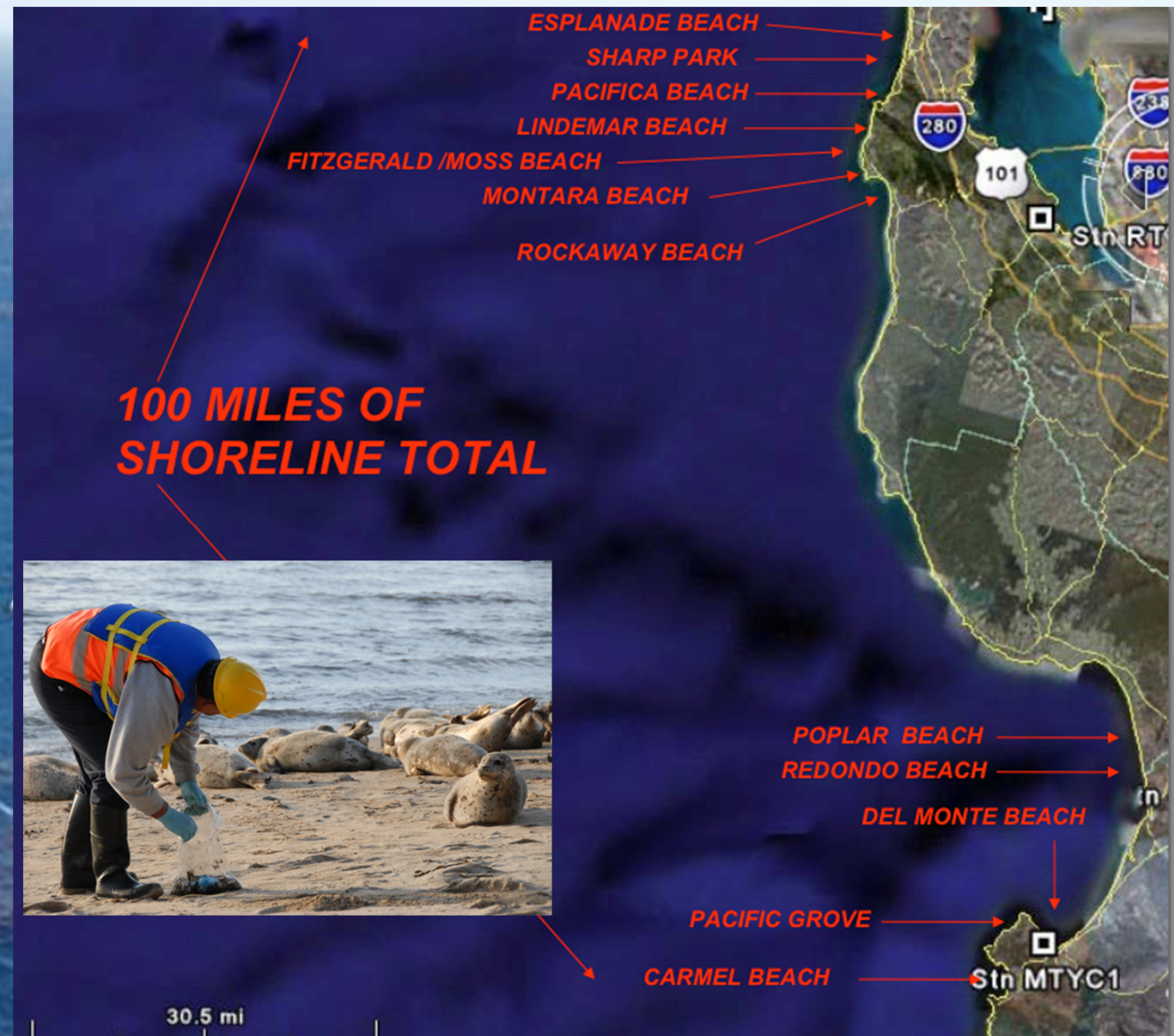
2012 OCSD Ocean Outfall Diversion
http://www.sccoos.org/projects/ocsd-diversion/

Asset Map and
Visualization
Moorings, gliders,
HF radar, casts,
Samples ….
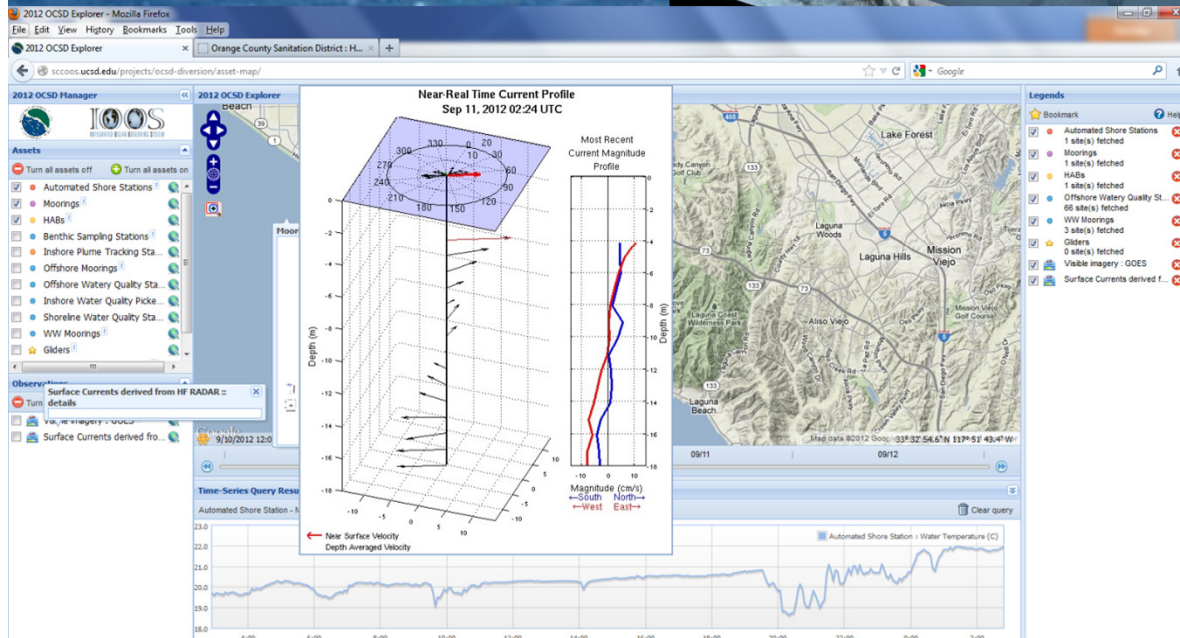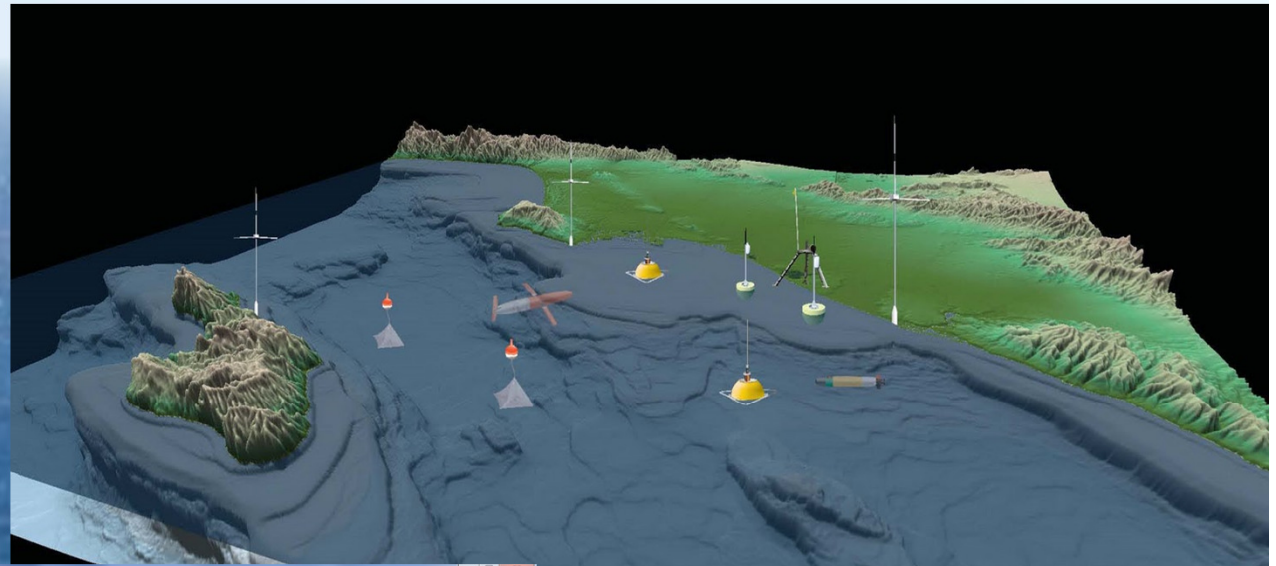
Case Study 3: Tar Balls

Late January 2008, oil and tarballs washed up on beaches from Monterey to San Francisco

They were determined to be from a natural seep, not from the Cosco Busan or other spil

ESPLANADE BEACH
SHARP PARK
PACIFICA BEACH
LINDEMAR BEACH
FITZGERALD /MOSS BEACH
MONTARA BEACH
ROCKAWAY BEACH

100 MILES OF SHORELINE TOTAL

POPLAR BEACH
REDONDO BEACH
DEL MONTE BEACH

PACIFIC GROVE
CARMEL BEACH
Stn MTYC1

30.5 mi

Surface current measurements showed that the tarballs'
appearance followed a period of exceptionally strong flow
from the south

Jan. 26, 2008
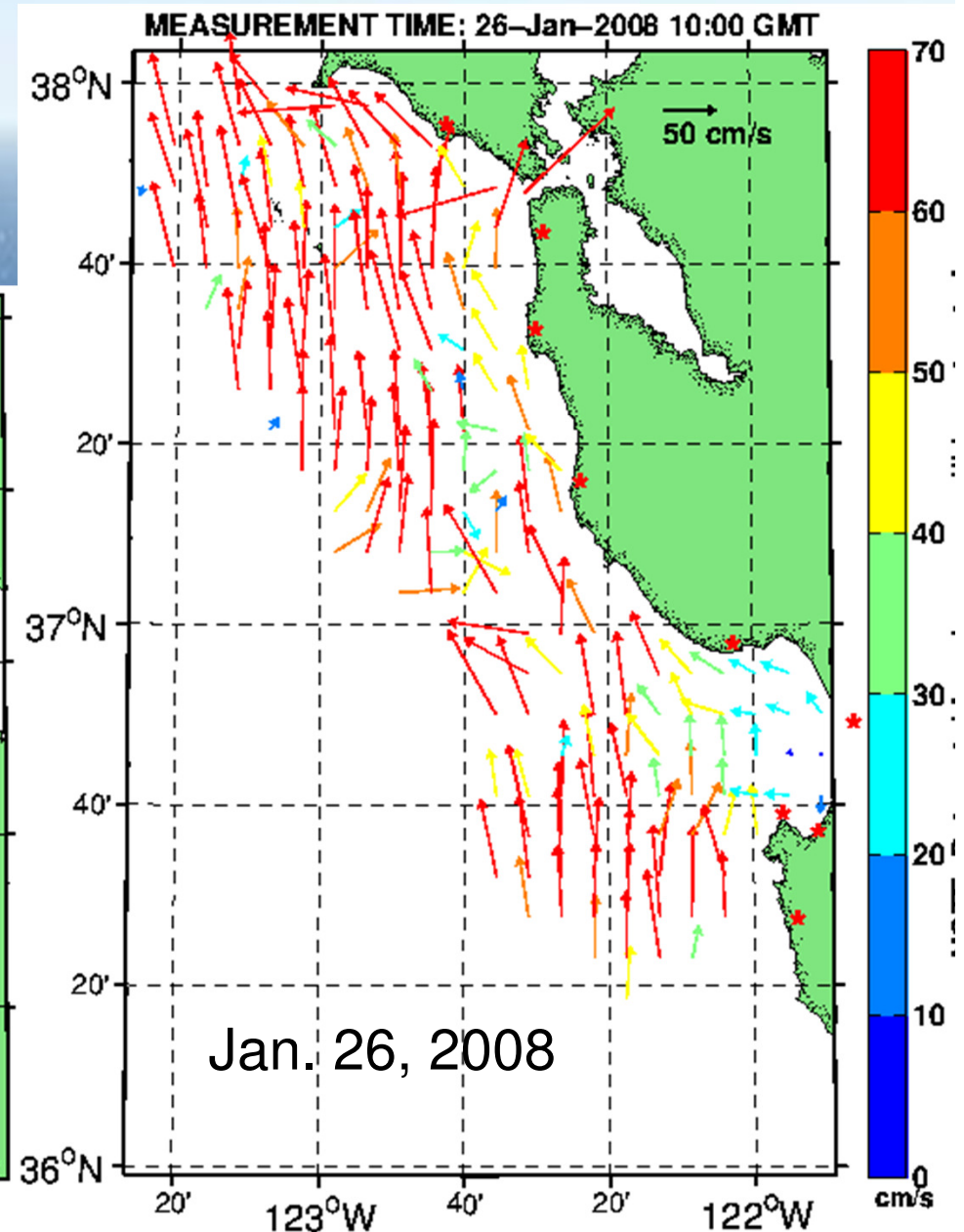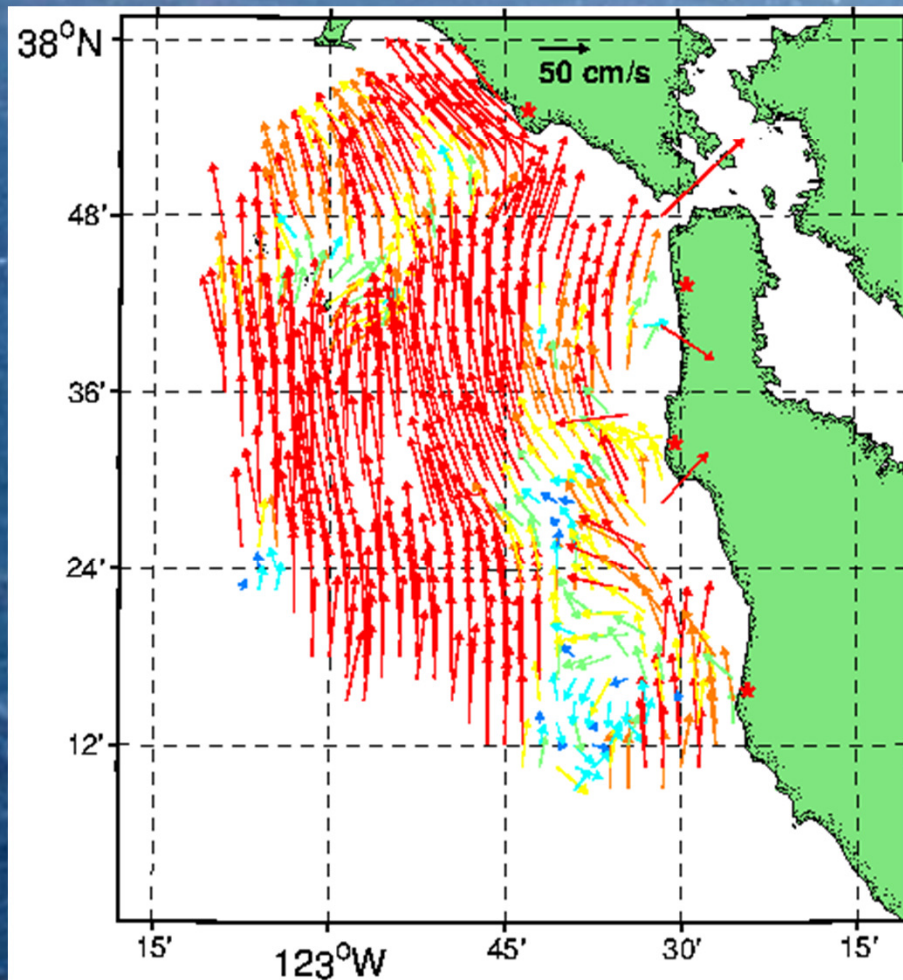
Northward flow continuous from Santa Barbara to San Francisco
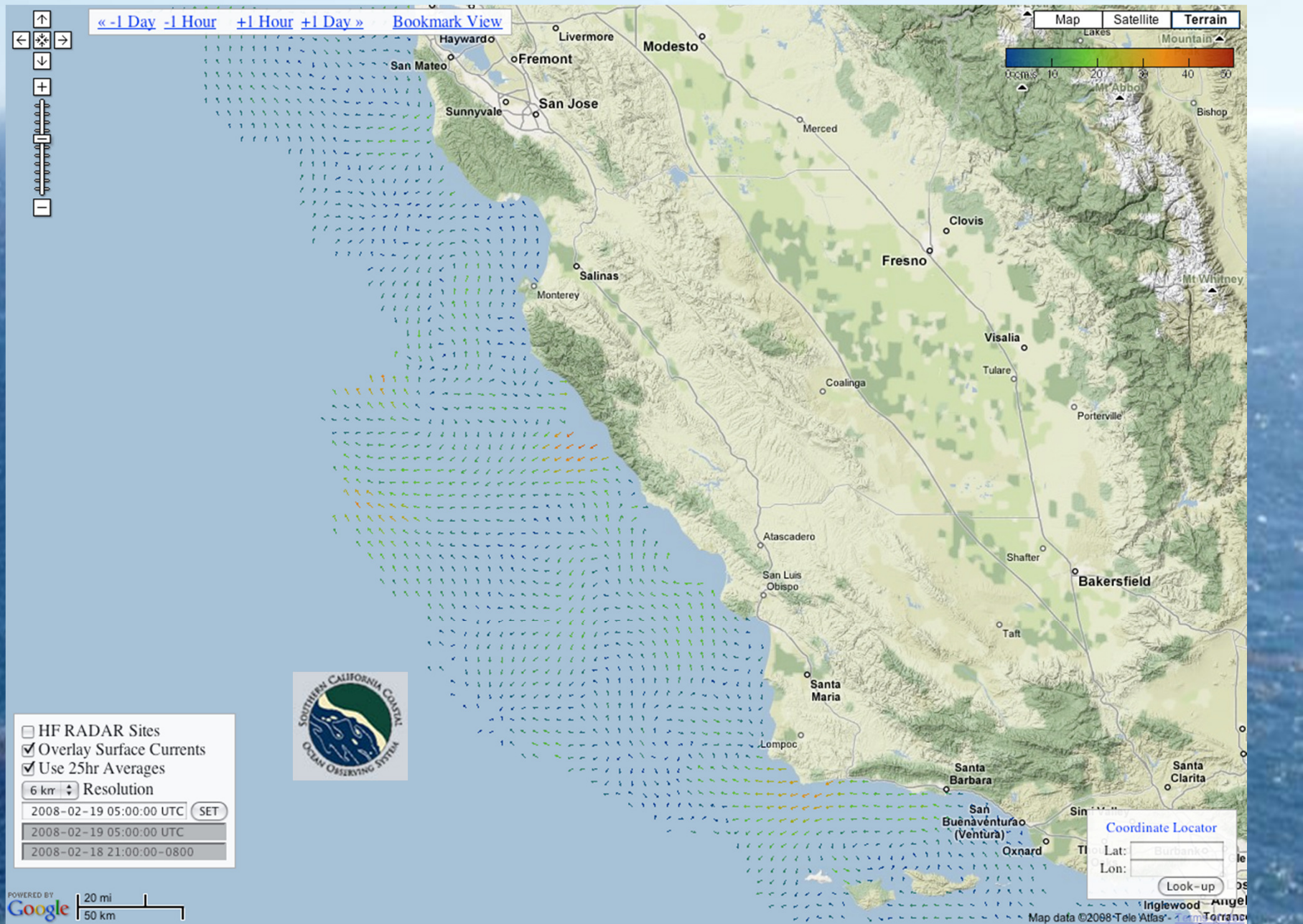
Hypoxia

- Low oxygen events have caused massive fish kills in harbors, like the one in Redondo Beach in March 2011

- Large scale low oxygen areas (also called anoxic or dead zones) have been observed off WA and OR. These have expanded from the continental shelf to near-shore waters every summer since 2002. The close proximity of these dead zones to the shore had never been reported before that year.
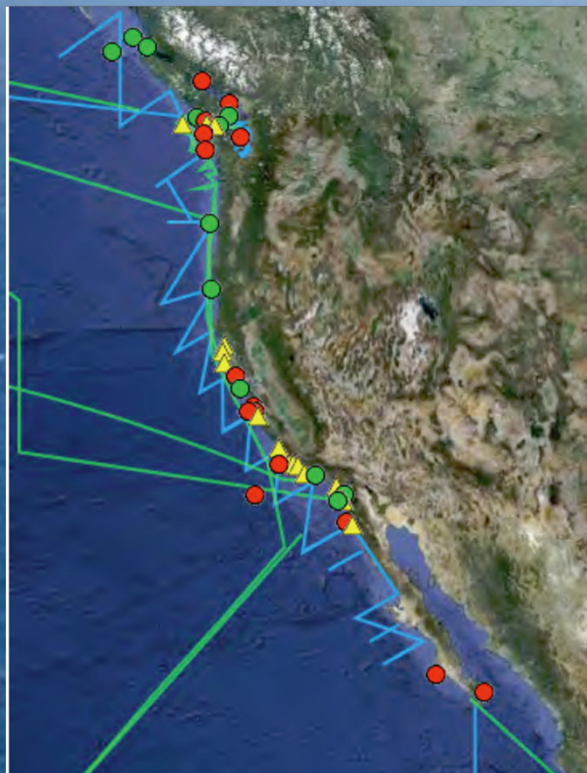
Low-oxygen conditions (<1.4 ml/l, blue) and extremely low-oxygen conditions (<0.5 ml/l, purple)
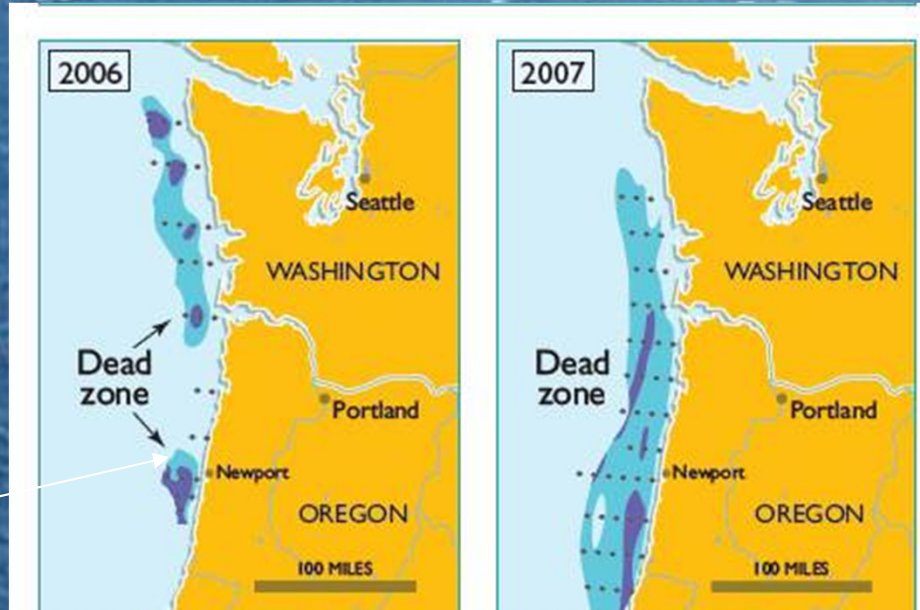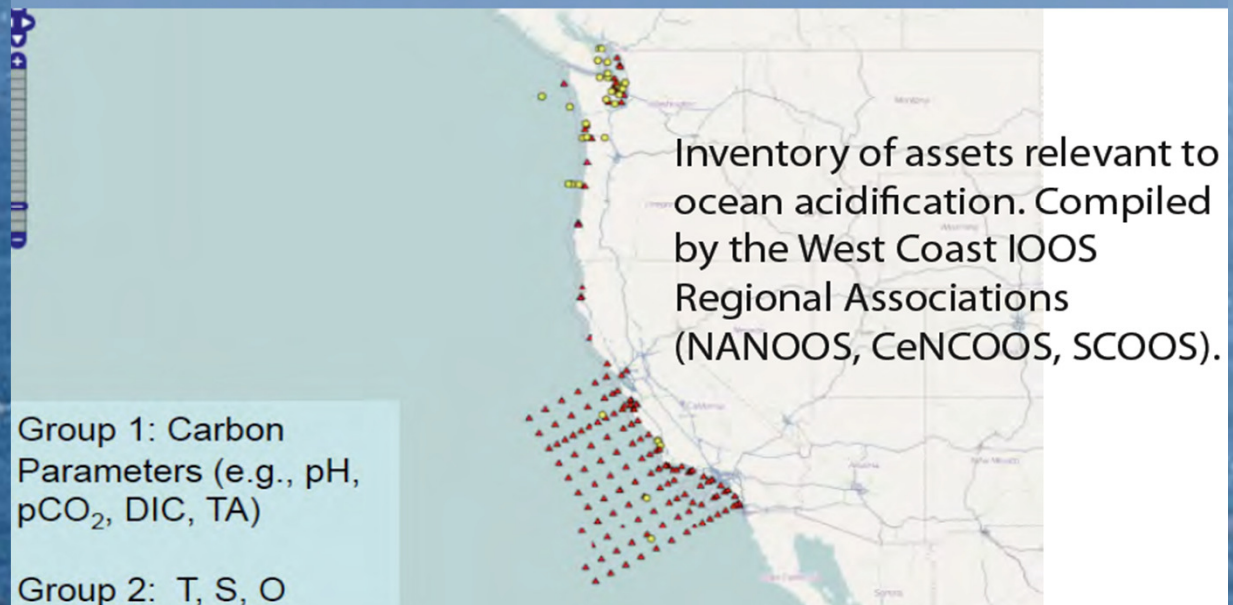
Ocean Acidification Efforts

It is important to note that OA efforts are in a preliminary stage

C-CAN
California Current Acidification Network

Group 1: Carbon Parameters (e.g., pH, pCO_2, DIC, TA)

Group 2: T, S, O

Inventory of assets relevant to ocean acidification. Compiled by the West Coast IOOS Regional Associations (NANOOS, CeNCOOS, SCOOS).

OA related time series along the west coast from NOAA Observing workshop in June 2012

Much of current carbon chemistry along the US west coast are unsuitable for needs of C-CAN stakeholders

Ocean Acidification Focus

http://www.pmel.noaa.gov/co2/OA2012Workshop/
http://c-can.msi.ucsb.edu/

- Raise awareness: OOSes can connect community to academics for expertise

- Shore Station Sensors – initially

- ID & test available technology for suitability

- Document best practices for instrumentation

- Integrate data handling and dissemination

- Provide education and training for participants